An Overview of the Common UNIX Printing System

This whitepaper describes the Common UNIX Printing System™ ("CUPS™"), a portable and extensible printing system for UNIX®. CUPS is being developed by Easy Software Products, a software firm located in Hollywood, Maryland that has been selling commercial software for Silicon Graphics®, Sun®, and HP workstations since 1993 through more than 40 distributors serving over 80 countries worldwide.

Additional information on CUPS is available on the World Wide Web at "http://www.cups.org".

Background

Printing within UNIX has historically been done using one of two printing systems - the Berkeley Line Printer Daemon ("LPD") [RFC1179] and the AT&T Line Printer system. Replacements for these printing systems have emerged [LPRng, Palladin, PLP], however none of the replacements change the fundamental capabilities of these systems.

Over the last few years several attempts at developing a standard printing interface have been made, including the draft POSIX Printing standard [IEEE-1387.4, last updated in 1994] and Internet Printing Protocol [IETF-IPP]. The POSIX printing standard defines a common set of command-line tools as well as a C interface for printer administration and print jobs. The Internet Printing Protocol defines extensions to the HyperText Transport Protocol 1.1 [RFC2068] to provide support for remote printing services.

Weaknesses in Existing Printing Systems

Easy Software Products has identified several major weaknesses in the printing systems currently in use:

1. Users must print text or Adobe® PostScript™ files; other formats *may* be supported, but not universally.
2. Lack of a standard command-line interface; each operating system and driver package provides different command-line options, e.g. setting the media size with one driver may involve passing a single option ("letter") while another requires two ("mediasize letter").
3. Lack of a standard application interface; most UNIX applications either do not provide an interface for sending printer options, or restrict the options to those in printer description files supplied with the application.
4. Remote printing problems; no vendor seems to use the same remote printing protocol (many use an "enhanced" version of the LPD protocol with vendor-specific extensions).
5. Client printer administration hassles; most vendors require that you install remote printers on each client by hand, and many do not even provide the ability to browse printers on the "server" system.

6. Drivers typically are hardcoded to handle printing to parallel or serial printers; support for other types of interfaces or networking protocols requires that a driver be rewritten to support them.
7. Security, accounting, and quotas; most printing systems do not support access control lists ("ACLs"), and printer accounting and quotas are not well supported, if at all.

Goals of CUPS

The basic goals of CUPS are:

1. Provide standard support for text (US ASCII, UTF-8, and ISO-8859-x), Adobe PostScript, PDF, HP-GL/2, TIFF, JPEG, PNG, PBM, PGM, PPM, GIF, SGI RGB, Sun Raster, and Kodak PhotoCD™ files.
2. Provide a standard command-line interface with a standard minimum set of options (media size and so forth).
3. Provide a standard application interface.
4. Provide a common remote printing interface (IPP).
5. Provide a printer browsing interface and allow users to print to remote printers using a "printer@server" notation rather than adding the printer locally.
6. Provide a scheduler extension interface to support different interfaces separate from the printer driver (e.g. serial, parallel, lpd, tftp, ipp, etc.)
7. Provide a standard interface for ACLs, quotas, accounting, and logging.

Design Overview

Like most printing systems, CUPS is designed around a central print scheduling process that dispatches print jobs, processes administrative commands, provides printer status information to local and remote programs, and informs users as needed. Figure 1 shows the basic organization of CUPS.
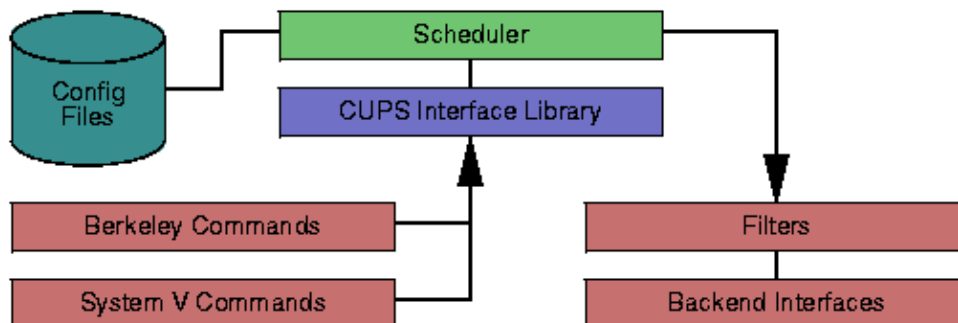

Figure 1 - CUPS Block Diagram

Scheduler

The scheduler is a HTTP/1.1 server application that handles HTTP requests. Besides handling printer requests via IPP POST requests, the scheduler also acts as a full-featured web server for documentation and status monitoring.

The scheduler also monitors the LAN for printer browsing information and dispatches print jobs as needed

using the appropriate filters and backends.

Configuration Files

The configuration files consist of:

- A HTTP server configuration file.
- Printer and class definition files.
- MIME type and conversion rule files.
- PostScript Printer Description (PPD) files.

The HTTP server configuration file is purposely similar to the Apache server configuration file and defines all of the access control properties for the server.

The printer and class definition files list the available printer queues and classes. Printer classes are collections of printers. Jobs sent to a class are forwarded to the first available printer in the class, round-robin fashion.

The MIME type files list the supported MIME types (text/plain, application/postscript, etc.) and "magic" rules for automatically detecting the format of a file. These are used by the HTTP server to determine the *Content-Type* field for *GET* and *HEAD* requests, and by the IPP request handler to determine the file type when a *Print-Job* request is received with a *document-format* of *application/octet-stream*.

The MIME conversion rule files list the available filters. These files are augmented by *cupsFilter* entries in the printer PPD files. The filters are used when a job is dispatched so that an application can send a convenient file format to the printing system which then converts the document into a printable format as needed. Each filter has a relative cost associated with it, and the filtering algorithm chooses the set of filters that will convert the file to the needed format with the lowest total "cost".

The PPD files describe the capabilities of PostScript printers. There is one PPD file for each printer.

CUPS Interface Library

The CUPS interface library contains CUPS-specific convenience functions for queuing print jobs, etc. It also contains functions to access resources via HTTP and IPP, perform MIME typing and conversion, and manipulate PPD files.

Filters

A filter program reads from the standard input or from a file if a filename is supplied. All filters must support a common set of options including printer name, job ID, username, job title, number of copies, and job options. All output is sent to the standard output.

Backends

A backend program is a special filter that writes incoming data to a device or network connection. Backends for serial, parallel, LPD, IPP, SMB, and AppSocket (JetDirect) connections are provided in CUPS 1.0.

Berkeley and System V Commands

CUPS provides the System V and Berkeley command-line interfaces for submitting jobs and checking the printer status. The "lpstat" and "lpc status" commands also show network printers ("printer@hostname") when printer browsing is enabled.

The System V administation commands are supplied for managing printers local to the system. The Berkeley printer administration tool ("lpc") is only supported in a "read-only" mode to check the current status of the printer queues and scheduler.

Summary

The Common UNIX Printing System provides a modern printing interface for UNIX applications that is both flexible and user-friendly. The software provides System V and Berkeley compatible command-line interfaces to ensure compatibility with existing applications.

Licensing

CUPS is available under the terms of the GNU General Public License which means that it is basically free except for binary-only distribution. Vendors wishing to license CUPS for their printing solution should contact Easy Software Products at:

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References

> *IEEE-1387.4*
>
> > System Administration - Part 4: Printing Interfaces (draft)
>
> *IETF-IPP*
>
> > Internet Printing Protocol/1.0
>
> *LPRng*
>
> > An enhanced, extended, and portable implementation of the Berkeley LPR print spooler functionality
>
> *Palladin*

A printing system developed at the Massachussetts Institute of Technology

PLP

The Portable Line Printer spooler system

RFC1179

Line Printer Daemon Protocol

RFC2046

Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types

RFC2068

Hypertext Transfer Protocol -- HTTP/1.1

Trademarks

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References